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CANADA DEPARTMENT OF AGRICULTURE

Research FOR FARMERS

CANADA DEPARTMENT OF AGRICULTURE
Ottawa, Ontario

HON. ALVIN HAMILTON
Minister

S. C. BARRY
Deputy Minister

SPRING — 1961

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"*Research for Farmers*" is published quarterly by the Canada Department of Agriculture. Its purpose is to help keep extension workers informed of developments in research and experimentation as carried on by the various units of the Department.

NOTES AND COMMENTS

Business firms make a practice of periodic stocktaking. The same technique can often be applied with profit to other enterprises as well. Last month the senior officers of the Department's Research Branch from all across the country gathered in Ottawa to review their past accomplishments and plan for future activities. Research may move in many directions but the terms of reference for the Research Branch are clear. In addressing the conference, Dr. Goulden, the Branch head, reminded his officials that the policy is "to provide service to the agricultural industry through research and experimentation, and to restrict our research to those problems related to increasing the quantity and improving the quality of presently existing or newly developed agricultural products, with due regard to the economic factors involved." Such a statement serves to focus attention on the ultimate goal of the research program service to agriculture. And the terms are sufficiently broad to tax the full resources of the organization.

* * *

Many industries are continually developing new products to tempt the consumers' fancy and stimulate sales. But Agriculture too has its eye on this opportunity. Increasing attention is being given to shaping the product to the requirements of the market (note article on Instant Mashed Potatoes, page 13). Among topics receiving study at the recent Research Branch conference was the development of new food products to meet or create consumer demand. Notable advances have already been made but there is plenty of room for further progress in this direction.

* * *

Sometimes a fortuitous circumstance results in an unexpected dividend from a piece of research. The Saunders variety of wheat was developed for use in the northern areas of Western Canada. It happens that wheat grown in these regions often develops piebald kernels, a condition indicative of low protein content and hence low quality. During a plant disease survey of wheat fields in Saskatchewan it was observed that the variety Saunders showed little or no evidence of the piebald character although it was prevalent to an unusual degree on certain other standard varieties. Researchers have speculated that the breeding program that developed Saunders may, without intent, have incorporated in the variety definite resistance to the piebald condition. Should this prove to be the case, a variety possessing this factor for resistance could be useful in future breeding programs as a means of eliminating this undesirable characteristic.

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***Cover Photo:* Crossbred ewes, CDA Research Station, Ste. Anne de la Pocatière, Que.**

Effects of broadcast ammonium nitrate fertilization at seeding time (110 lb./A 33.5-0-0) and the pre-planting application of Avadex (1½ lb./A) on wild oats and flax.

		Plot No.	*Wild Oats No./sq. yd.*	*Wild Oats Control—%*	*Flax Yield Bu./A*
No fertilizer	No Avadex	12	96	...	7.0
	Avadex	11	19	80.4	10.9
Fertilizer	No Avadex	8	476	...	1.9
	Avadex	7	26	94.5	12.2

Fertilizers, Herbicides and Wild Oats

J. J. Sexsmith

FERTILIZERS AND HERBICIDES have proved to be useful tools for the production of more crops with less weeds in a wide range of conditions. However, work conducted by the Lethbridge Research Station has shown that where the wild oats is involved it becomes hazardous to generalize.

In fertilizer tests conducted on wild-oats-infested land in the Stavely area, a combination of nitrogen and phosphorus resulted in an increase in wheat yield of up to 50 per cent but caused an increase in production of wild oats seed of 100 to 200 per cent. Such results point out the inadvisability of considering only crop yield to measure the value of a seemingly good agronomic practice.

Not only can wild oats plants grow better and produce more seed when fertilizer is supplied, but under both laboratory and field conditions nitrates have been shown to break seed dormancy. The effects of nitrate under field conditions were studied in 1959 at Magrath on a heavily and uniformly infested area. Over five times the wild oats population was present in the crop that received a 110-pound broadcast application of ammonium nitrate (33.5-0-0) fertilizer three weeks prior to seeding than was present in the adjacent unfertilized crop.

Present-day herbicides show promise for the control of wild oats in some field crops. Their value on a yield improvement basis ranges from fair to excellent, the differences being dependent on both the crop and the specific herbicide.

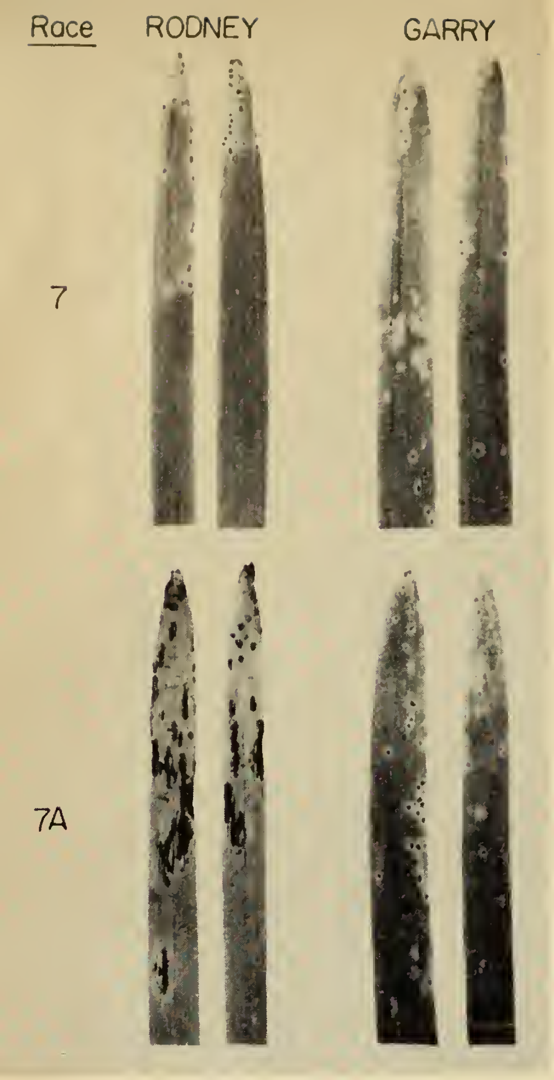
Carbyne used in wheat has given some yield increase and up to 80 per cent reduction of wild oats tillering in tests conducted at Lethbridge. In other tests Avadex at 1.5 pounds per acre resulted in a wild oats control (i.e., stand reduction) of 80 per cent with an accompanying increase in flax yield of 55 per cent. A yield increase of such magnitude would not be expected from equal wild oats control in some other herbicide-tolerant crop offering more competition than does flax.

Two tests conducted in 1960 indicate the complex interaction of herbicide and fertilizer in flax infested with wild oats. Without herbicide treatment the broadcast application of 110 pounds of ammonium nitrate fertilizer at time of seeding caused an increase in the wild oat population of 400 per cent and a *decrease* in flax yield of 73 per cent. When Avadex at 1.5 pounds per acre was used in conjunction with fertilizer as mentioned above, 94 per cent wild oats control resulted and an *increase* in flax yield of 540 per cent over fertilizer alone was obtained. Complete information on wild oats seed production was not obtained in this particular test. At another location, which had received a preseeding application of ammonium nitrate, an increase in flax yield of 170 per cent accompanied a 95 per cent reduction in wild oat stand due to Avadex treatment. However, this stand reduction was not reflected in wild oats seed production, which was reduced by only 55 per cent. It seems obvious that, unless a herbicide were to be used for wild oats control, an early or seed-time nitrogen fertilization of infested land should not be applied for flax.

Research in progress at various locations throughout Western Canada is aimed at finding some of the fundamentals of wild oats growth, seed dormancy, and plant

Concluded on page 7

The author is a weeds specialist at the Research Station, Lethbridge, Alta.



Upper leaves show resistance of both Rodney and Garry to Race 7 of oat stem rust. Lower leaves reveal the susceptibility of Rodney and the resistance of Garry to Race 7A of stem rust.

Problems and Progress in Breeding Rust Resistant Oats

R. I. H. McKenzie

AND

G. J. Green

OATS have been subject to rust attacks on the eastern prairies since agricultural development of the area began. Losses were most severe in the early years but as recently as 1955 late fields of susceptible varieties were severely damaged.

The seriousness of the rust problem led to the establishment, in 1925, of the Rust Research Laboratory at Winnipeg. The main objective of the oat breeding program at the Laboratory was to develop varieties resistant to both stem rust and crown rust (leaf rust). Additional objectives were the improvement of yielding ability, straw strength, kernel plumpness, and the addition of smut resistance.

Varieties produced by the breeding program, carried on from 1925 to 1960 by J. N. Welsh, have controlled stem rust in most years since 1936 and have reduced the severity of crown rust attacks in the past six years. The first of these varieties, Vanguard, released to farmers in 1936, was followed in 1941 by the varieties Ajax and Exeter. All three were resistant to stem rust races 1, 2, 3, 5, 7, and 12 but susceptible to races 4, 6, 8, 10, 11, and 13, and to crown rust. Races 8, 10, and 11 then became predominant, and in 1944, 1945, 1947, and 1950 they attacked the formerly resistant varieties. In 1954 Rodney and Garry were distributed to farmers. Both of these varieties were resistant to the prevalent races of stem rust and crown rust.

The high resistance of Rodney and Garry was short-lived. The number of crown rust races capable of attacking them increased rapidly and today they are susceptible to most of the crown rust occurring in Canada. However, because of unfavorable conditions for rust development, these races have not caused serious damage to either variety. In 1953 a race of stem rust able to attack Rodney was found in Manitoba. This race, known as 7A, has increased slowly and has not caused serious losses. In 1957 races of stem rust capable of attacking both Rodney and Garry appeared in Eastern Canada but they have not spread to the main oat growing areas in the central great plains.

The "years of grace" between the appearance of a new and dangerous race and its rise to predominance, give breeders and pathologists an opportunity to develop resistant varieties before serious losses occur. But the time may be short and it must be used as efficiently as possible.

First, the new race must be detected promptly. For this purpose rust nurseries are grown throughout Canada and observed for new races. Oat workers in all parts of the country constantly watch for rust on resistant varieties and send collections to Winnipeg for race identification. Each rust culture is tested on certain key varieties that help to establish its range of pathogenicity.

When a dangerous new race is discovered a source of resistance to it must be found quickly. First, the known sources of resistance are tested to determine if any are effective against it. Then, new sources of resistance are sought by testing many varieties from various parts of the world. By means of these tests, a source of resistance to the new races of stem rust virulent on Rodney and Garry was quickly found in the variety R.L. 524, which inherited its resistance from the North African variety Hajira. This discovery was unexpected because this source of resistance was believed exhausted. The varieties Vanguard and Ajax inherited a gene from Hajira, known as the "A" gene, which confers resistance to races 1, 2, 3, 5, 7, 7A, and 12. The variety Rodney inherited a different gene from Hajira, known as the "B" gene, which confers resistance to races 1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, and 13. Garry, also derived from Hajira, carries the "A" and "B" genes. When R.L. 524 was tested, some of the plants were resistant to the new races. Further investigation demonstrated that these plants are resistant to all the races found in Canada. Genetic studies showed that this new kind

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of resistance from Hajira is controlled by a gene, designated the "F" gene. The discovery of the "F" gene made possible the prompt initiation of breeding programs designed to produce varieties resistant to the new races.

There are other genes for stem-rust resistance in addition to those found in Hajira. The "D" gene, carried by the variety White Tartar and a number of American varieties, confers resistance to races 1, 2, 5, 8, 10, and 11. The variety Joanette carries the "E" gene which confers resistance to races 1, 3, 4, and 11.

The rust problem is world-wide and rust workers in many countries have found it profitable to cooperate in growing the International Rust Nursery which is coordinated by the United States Department of Agriculture. Oat breeders from many parts of the world enter their most resistant varieties in the nursery which is grown at 20 locations in 12 different countries. Thus, in a single year, the varieties are tested many times in field nurseries against many races of rust. New sources of resistance are quickly revealed and the degree of resistance of new hybrids is evaluated under a wide range of conditions.

When resistance of a suitable type is found, it must be transferred to an acceptable variety. The time and effort required to produce a resistant variety is indicated by the pedigree of Rodney oats, shown below. Rodney obtained resistance to crown rust and smut from Victoria, and the "B" gene from Hajira conferred resistance to stem rust.

Hajira × Banner (1926)

Victoria × Hajira (1930)

Victoria × R.L. 524 (1930)

R.L. 1102 × R.L. 1268 (1939)

R.L. 1574 × Roxton (1943)

Rodney (released in 1954)

The task of producing a new resistant variety is not always accomplished easily. For example, an attempt was made to improve the crown-rust resistance of Garry by crossing it with Santa Fe, a highly resistant variety from South America. Although numerous hybrids from this cross have been tested, none appear to have both the crown-rust resistance of Santa Fe and the yielding ability of Garry. Difficulties may arise with characters such as yield which are controlled by many genes which complement one another. Such genes recombine at random and the recovery of the high yield and rust resistance of Garry combined with additional rust resistance from Santa Fe might require a hybrid population too large to be dealt with in a normal breeding program. A further complication could be caused by what geneticists call linkage. If the desired gene for rust resistance is located on a chromosome very close to another gene for an undesirable character it might be difficult to separate the two.

In order to have some assurance of obtaining rust-resistant varieties with high yield, strong straw, and large kernels it has been necessary to turn to backcrossing. In this procedure a good variety like Rodney, which lacks adequate rust resistance, is crossed with a more resistant variety, for example, a variety resistant to race 7A of stem rust. Among the progeny of the cross a plant resistant to race 7A is selected and crossed with Rodney. From the progeny of the second cross a resistant plant is again selected and crossed with Rodney. This procedure of crossing several times to one recurrent parent is called backcrossing. Usually from 4 to 8 backcrosses are made to the desirable variety. After the last backcross the progeny are all similar to Rodney in appearance and yielding ability and some possess resistance to race 7A. Selections from the last cross could be released as a new variety that is similar to Rodney except in resistance to race 7A.

Backcrossing is being used to improve the rust resistance of both Garry and Rodney. The "E" and "F" genes for stem rust resistance, and crown rust resistance from Ceirch dubach and Santa Fe are being transferred to both Garry and Rodney. The "A" gene for stem rust resistance is being transferred to Rodney. The varieties resulting from this program should be similar to Rodney and Garry and more rust resistant than any known commercial variety.

It is essential in breeding rust resistant oats to produce varieties with resistance to new races before these races can damage the old varieties. Continued success can only be achieved by unceasing vigilance in the detection of new races, a constant search for new types of resistance, and a vigorous plant breeding program designed to produce superior resistant varieties.

Plant Pathology Greenhouse showing compartments where races of rust are identified.

Three-lobe spirea, one of the best for the West.

Woody Ornamentals for Prairie Canada

W. A. Cumming

WOODY ORNAMENTALS have re-received a major share of attention at the Morden Experimental Farm from the time the first plantings were made in 1916. Some species have proved adaptable and have been widely distributed; others have quickly passed out of the picture either from lack of hardiness or lack of usefulness as ornamentals. The Morden collection now contains 1,445 species and varieties representing 113 genera of trees and shrubs. There are 144 new sorts in the propagating frames or in the nursery awaiting permanent placement in the arboretum. Generic group plantings are being organized, particularly in those genera in which breeding and selection is in progress. This system will make the evaluation of new varieties and selections much easier. Older plantings, which in most cases were planted in order as received, are being maintained and provide much useful information on ultimate size, longevity and the best method of culture.

Many species of trees and shrubs have a wide geographic distribution and, from the hardiness standpoint, the source of the plants under test is most important. For example, Siberian elm from southern Asia proved unreliable but trees grown from seed secured in Manchuria have abundant hardiness. Seedlings of sugar maple selected from the western and northern limits of the natural range of the species have extended its adaptation. Three generations of seedlings have been grown at Morden and young sugar maple trees produced from Morden seed look promising in several locations across the Canadian Prairies.

The author is a specialist in ornamentals at the Experimental Farm, Morden, Man.

Because it is a favored area climatically, there is little likelihood that plants that prove tender at Morden will survive elsewhere on the prairies. The atypical climate at Morden means that final hardiness evaluation must be carried out elsewhere. To this end, five other horticultural institutions, strategically located to cover the important hardiness zones of the Canadian Prairies are co-operating with the Morden Experimental Farm.

Some of the newer species of trees and shrubs that have already or will shortly find their places in prairie landscape plantings are:

From Manchuria:—Amur corktree, Amur maackia, Amur choke cherry, Amur honeysuckle, Manchurian ash, Manchurian walnut, Manchurian crabapple and Manchurian weigela;

From Northern China and Eastern Siberia:—Mongolian oak, Mongolian basswood, winged euonymus and threelobe spirea;

From Northern Korea:—Korean barberry, winged euonymus (Korean form), early forsythia and Sakhalin honeysuckle;

From Japan:—Japanese tree lilac;

From other parts of North America:—Arnold, river and downy hawthorns, black walnut, Ohio buckeye, coyote willow and western yellow pine;

From our own area:—pagoda and gray dogwoods, ironwood, hackberry and silverberry.

This listing does not include the many horticultural varieties that have been introduced or are the products of prairie plant breeders.

Morden Introductions

In our breeding program at Morden we are emphasizing the development of new varieties of ornamental crabapples, shrub roses, late hybrid lilacs, mock-oranges, flowering almonds, weigelas, honeysuckles, hawthorns and viburnums. Selection is not based entirely on the production of beautiful flowers, but rather on the factors that make for continuous interest throughout the year.

Japanese tree lilac, an excellent, hardy, large shrub.

Two varieties of ornamental crabapples have been named and introduced from Morden. Almey rosybloom crabapple, released in 1945 was selected from seedlings of a cross between redvein apple and Siberian crabapple. Since its introduction Almey has become one of the most popular and highly rated ornamental crabapples on this continent. In 1947 the variety Sundog was released. At present 59 selections from other crosses are being evaluated. Five of these, their ornamental value having been established in the Morden trials, have been propagated and sent out for hardiness evaluation. Breeding for hardy double-flowered forms commenced in 1960.

Three varieties, Royalty, Coral, and Redwine, out of the seven late hybrid lilacs named and introduced at Morden, are grown in American and European gardens. Royalty and Coral are both hardier than Redwine. Seventy-five selections, some from open-pollinated seedlings but most from controlled crosses, are being evaluated. They include some excellent pink-flowered hybrids.

Toba is a hybrid between a double pink form of the English hawthorn and the native fleshy hawthorn. Besides doing well on the prairies, Toba is competitive in areas where other double-flowered varieties are popular.

Hardy shrub roses with compact habit, good textured clean foliage, clear-colored double flowers, with bright winter bark color and showy fruits are desired. Of the three varieties which were named in earlier years only Prairie Youth has found acceptance by prairie gardeners. Three new varieties, Prairie Charm, Prairie Dawn and Prairie Maid will be available from commercial sources, for the first time, in 1961.

Silvia mockorange, unfortunately too tender for most regions of the Canadian Prairies, is increasing in popularity in less severe climates. Its graceful form, double white, sweetly-scented flowers, which are produced later in the season than those of other named varieties, combined with its bright tawny winter bark, are the reasons for its increasing popularity. The breeding program with mock-

Siberian crabapple is a good ornamental tree, but more notable as the source of hardiness in both flowering and culinary crabapples.

oranges emphasizes hardiness in double-flowered forms. Fourteen selections are under test.

Hardier weigelas have been obtained by crossing varieties such as Bristol Ruby, Vanicek and Wagner's Profusion with a hardy Manchurian form. Eight promising selections, with larger and brighter colored flowers than the hardy parent, are under test. Second-generation seedlings of these crosses are also being grown.

Other Morden introductions listed by commercial nurserymen are: Redman elder, Tidy caragana, Prairie almond, Muckle plum, Morden elm, Morden spruce, and Nocturne lilac. In all, 28 new varieties of woody ornamentals

Sugar maple—as it grows at Morden, Man.

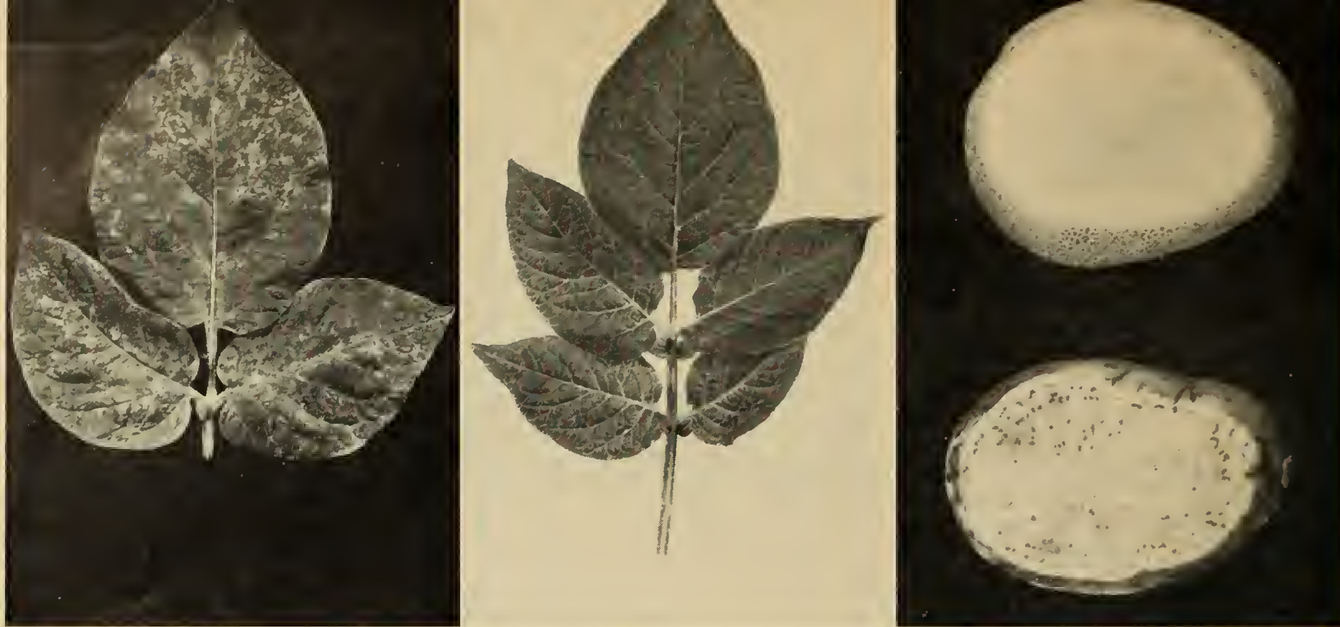
have been named and introduced. If future introductions are as successful as some of those listed above, the Morden Experimental Farm will continue to play a major role in the development of new varieties of shrubs and trees for landscape planting on the prairies.

Fertilizers, Herbicides and Wild Oats . . . *from p. 3*

behaviour in relation to herbicides. At Lethbridge we have found that temperature plays a part in wild oats dormancy; seed produced under high temperatures (80°F.) is less dormant than seed produced under low temperatures (65°F.). Also, it has been found that there is variation in the amount of dormancy between the four commonly occurring varieties of wild oats and that within any one variety there is variation from plant to plant.

Such facts may not seem to be too important to the farmer plagued with a wild oats problem. However, as the secrets of the "beast" are exposed and the strong and weak points in its nature determined, only then will it be possible to interpret the facts and propose practical measures for the control and eventual eradication of what is now considered the No. 1 pest of the prairie farmer—wild oats.

When this happy day arrives, it seems certain that fertilizers and herbicides, along with other "tools", will be used in the eradication procedure.



Immunity. The "mild mosaic virus"—A—(left); the "latent viruses"—S and X—in an outwardly healthy leaf (center); and net necrosis injury (right) could disappear from potatoes if only immune varieties were grown.

Count-Down on the Potato Viruses

R. H. Bagnall

AND

J. P. MacKinnon

To the uninitiated, even amongst plant pathologists, the potato virus diseases are a complex lot. Some viruses seem almost harmless, whereas others, alone or in combination, can turn the plants into discolored, twisted, and stunted relics. In the accompanying box, we list eight viruses that occur in Canada. There are more, but effective control of these would be a boon to growers. Through the creation of resistant varieties, research provides the answer, and a significant part is coming from the Department's potato research center at Fredericton, N.B.

Each virus is given a code-letter or self-explanatory name. The diseases are also named from the most obvious symptoms, but it is not really so simple. The letters are used because some viruses cannot be identified by symptoms. Often several viruses are present in a diseased potato, and even the supposedly harmless or "latent" ones contribute their share to the damage. Only by elaborate tests can each be detected.

All but one of the eight viruses are carried over in the tubers; the aster yellows virus being established in perennial weeds. The viruses are spread by various contacts between diseased and healthy plants, or by sap-feeding insects such as aphids and leafhoppers. Migrant leafhoppers bring the aster yellows virus in with them, and the aphid-borne viruses are spread within the crop, mostly by the active winged-migrants. No known insecticide acts quickly enough against these migrant insects to be of much use in virus control.

Viruses do not enter the embryo of the true seed, so potato seedlings start their lives virus-free. Laborious schemes are followed in Europe to keep important varieties healthy. In North America, viruses S and X are generally tolerated—and most varieties, though outwardly healthy, are entirely infected with both. Our seed certification is concerned with visible diseases caused by viruses A, M, and Y, or the leafroll and spindle tuber viruses. The aster yellows virus is ignored unless infection is heavy. But, certification has not eliminated the problem, and if it were stopped now—after 45 years—our potato stocks would soon "degenerate".

We would not return, however, to the conditions known in the early part of this century. Along with the classical works of isolating and describing the viruses, pathologists have, with help from plant breeders, developed varieties resistant to most of them. Unlike fungus diseases where mutation of the pathogen has often overcome resistance, resistance to viruses appears to be lasting. So, for some of the viruses, a cautious count-down has already begun. Oddly, this has received little publicity, perhaps because the viruses have caused no dramatic crop failures—and possibly because outsiders are confused by the numerous viruses. But, the varieties most widely grown today are resistant to several important viruses, whereas well known older varieties whose popularity has declined, are susceptible to nearly all.

The varieties Saco and Tawa are immune to virus X, and Saco, we have found, is practically immune to virus S. As a step toward the control of the latent viruses, these varieties show promise.

There are two types of resistance to virus A, but to the grower both

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The authors are potato virus specialists at the Research Station, Fredericton, New Brunswick.

Resistance. The "rugose mosaic virus"—Y—(left) has been greatly reduced; and the leafroll virus (right) may be next. *At right:* Hope? Spindle tuber is getting more troublesome—but increased attention.

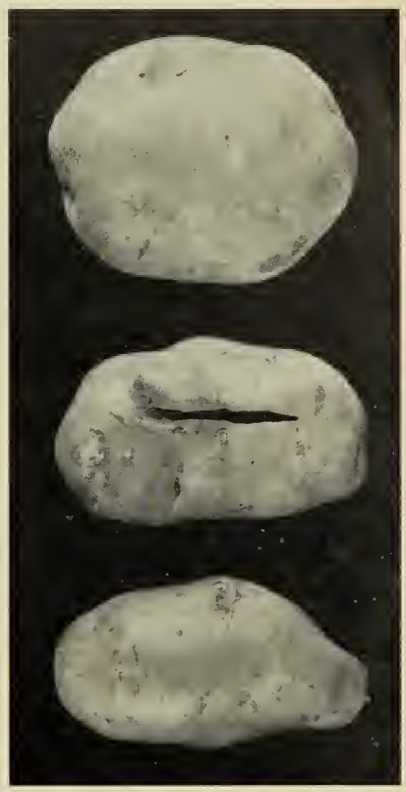
amount to immunity. One type, found in Avon, Canso, Fundy, Huron, Irish Cobbler, Saco, and Tawa, is based on hypersensitive reaction in the resistant plant. Individual cells die so quickly that the virus is localized at the point of entry. The second type of resistance is not so well understood. Varieties including Chippewa, Katahdin, Kennebec, Sebago, and Warba simply do not become infected in the field.

We have also a hypersensitive-like resistance to virus Y, found in Burbank, Chippewa, Katahdin, Kennebec, Saco, and Warba. It is not quite immunity, but resistant varieties are infected much less frequently than are the susceptible. Some wild species of potato are immune to virus Y, but transfer of the characteristic to a commercial potato may be difficult.

No commercial variety has significant resistance to the leafroll virus, although some seedlings have—including several developed at Fredericton. Some varieties such as Chippewa, Katahdin, Kennebec, and Saco do escape an internal tuber injury, net necrosis, that is outwardly invisible and most annoying to the consumer.

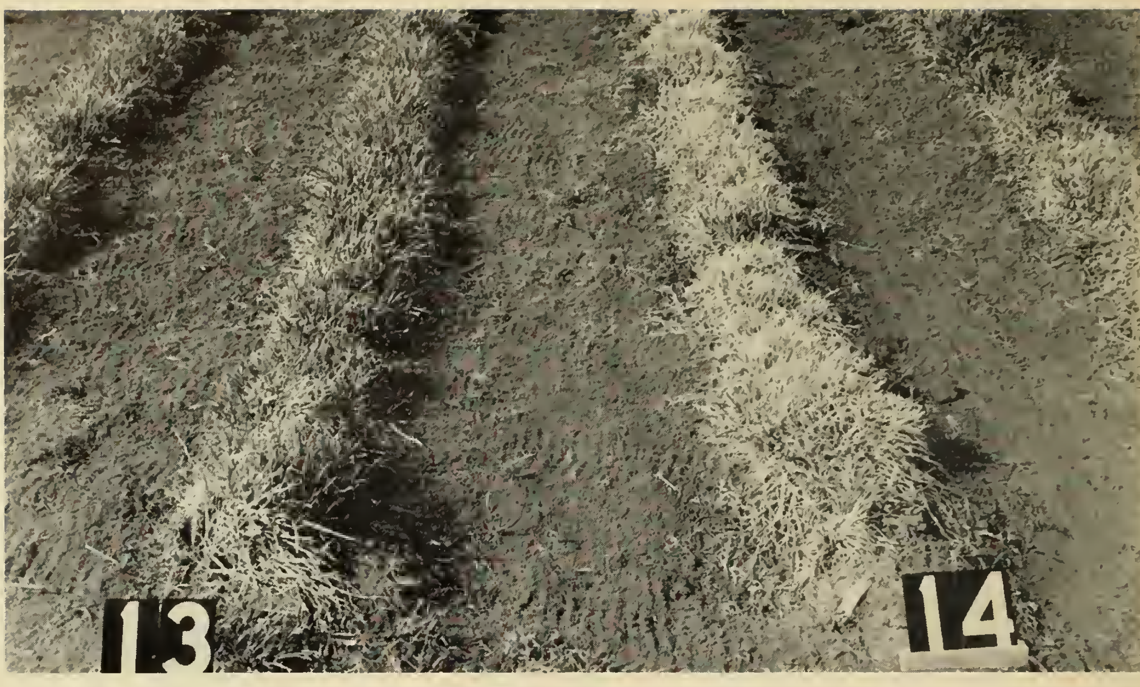
The potato is a relatively poor host for the aster yellows virus. We are not certain how extensively the virus can penetrate within infected plants, but it does not seem to be far, for one or two years' tuber propagation will again produce healthy potatoes.

The search for resistance to virus M has only begun. But, the spindle tuber virus has been studied for 40 years, yet it is probably the least understood of all. Spindle tuber has lately become more and more troublesome. Little is known about resistance.



Potato Viruses in Canada

Virus	Common Diseases	Spread by	Occurrence	Resistance	Other Control
X	Usually symptomless	Contact	Susceptible varieties almost 100% infected	Immune varieties	Serological and index-host tests
Y	"Rugose mosaic" in susceptible varieties; "streak" in resistant	Aphids	Infection usually small; can increase rapidly	Resistant varieties; immune wild species	Field roguing; greenhouse eye-indexing; "Florida tests"
A	"Mild mosaic"	Aphids	Infection usually small, but hard to eliminate	Immune varieties	Same as virus Y
S	Usually symptomless	Contact	Susceptible varieties almost 100% infected	Immune variety	Serological tests
M	"Leafrolling mosaic" "Interveinal mosaic"	Aphids	Widespread but incidence unknown	Unknown	Serological tests
Leafroll	Leafroll; "net-necrosis"	Aphids	Infection usually small; has been serious	Resistant seedlings; varieties free from "net-necrosis"	Same as virus Y
Spindle tuber	Spindle tuber	Unknown	Becoming troublesome	Unknown	Field roguing; tuber selection
Aster yellows	"Purple top; yellow top"	Leafhoppers	Sporadic, but can be severe	Potato "resistant"	Unknown



Contrast of winter killing in orchard grass: 13—one of the lines in Chinook; 14—Akaroa, a non-winter-hardy introduction from New Zealand.

Chinook Orchard Grass

R. W. Peake

CHINOOK, a winter-hardy orchard grass developed at the Canada Agriculture Research Station, Lethbridge, Alta., should make an important contribution toward advancing the pasture program of Western Canada.

Chinook orchard grass exhibits more winter hardiness than any other variety tested at the Lethbridge Research Station. Not only will this variety ensure better pastures on irrigated land but it will extend the use of orchard grass in many non-irrigated, moist areas of Western Canada. The added feature of early spring vigor will permit earlier grazing thus extending our very limited grazing season.

Although this grass is not new to North America it is only recently being recognized for its potentialities. It is a native of Europe where it is called cocksfoot and was introduced to North America about 1750. First used in the southeastern United States, it immediately became popular because of its early spring growth and quick recovery. It is persistent and remarkably adapted to a wide range of soil and climatic conditions. Its main limitation has been inability to survive the severe winter conditions of the northern United States and Western Canada.

At Lethbridge orchard grass was first seeded about 1915 and despite periodically severe winters which caused extensive winter injury, some plants have survived every year since its introduction. From the first seeding the potential value of this grass was recognized but the need for a hardy variety was apparent. One of the major problems of selecting for hardiness at Lethbridge was the variability of winter conditions. During many of the years even the least hardy varieties were not injured. Nevertheless, a program of improvement was started in 1939 with the collection of seed from a stand that had persisted for 25 years. This seed was used to establish an observation nursery.

First individual plant selections were made in 1946 when 1,200 plants were taken from the original seeding and set out in a spaced plant nursery where they could be critically observed. To this nursery were added plants taken from the Hatfield ranch near Twin Butte, Alberta. Out of this large nursery, 51 superior, leafy and high-yielding plants were selected. These plants were divided so that each could be planted out in individual rows.

Continual selection for resistance to winter injury coupled with early spring vigor and yield further reduced the number of lines to 9 by 1951. These selections were combined into four lines and tested at a number of locations across Canada. As a result of these tests a final recombination of lines was made into a synthetic variety, Chinook.

Chinook orchard grass promises to be a valuable forage crop in Western Canada.

The author is Head, Forage Crops Section, Research Station, Lethbridge, Alta.

Dr. Asselbergs checking production. Potatoes are peeled, diced, boiled, mashed and passed between dehydrating steam-heated rollers.

Instant Mashed Potatoes . . .

C.D.A. Develops New Process

THE door to increased Canadian manufacture of processed potatoes—and possibly greater use of the Canadian-grown potato—has been opened by a Canada Department of Agriculture researcher.

Dr. E. A. Asselbergs of the Plant Research Institute at Ottawa has developed a process for making instant mashed potatoes of such high quality that it is claimed the taste cannnot be distinguished from the mashed potato produced with much labor by the housewife in her kitchen.

Patents have been applied for by the government. Manufacturers in Canada and the United Kingdom who have sampled the product have shown great interest and it is likely that the packaged product will be for sale in retail stores by the fall of 1961.

Only a year ago Dr. Asselbergs led a scientific team to first place in the research of infrared heat for blanching fruits and vegetables prior to freezing and canning.

Agriculture Minister Alvin Hamilton paid public tribute to the discovery of the new process at the recent meeting of the Canadian Horticultural Council. He said the instant potato process on which patents have been filed will likely be known as the Asselbergs process. "It is a compact product resembling a powder or crystal and both our own and independent appraisals of it, based on production on a laboratory scale, indicate that it makes a very good quality instant mashed potato... I think it is fair to say that it is one in a long series of contributions which our research workers have made to Canadian agriculture."

Dr. Asselbergs used a standard drum drier, designed for making powdered milk, to convert the potato into the crystal form, ready for use in the kitchen. Potatoes are peeled, diced, boiled, mashed and passed between the steam-heated drums. Similar products have been imported in increasing quantities into Canada. In the home the addition of hot water and milk converts the crystals—in some brands they are flakes or granules—into a ready-to-eat dish.

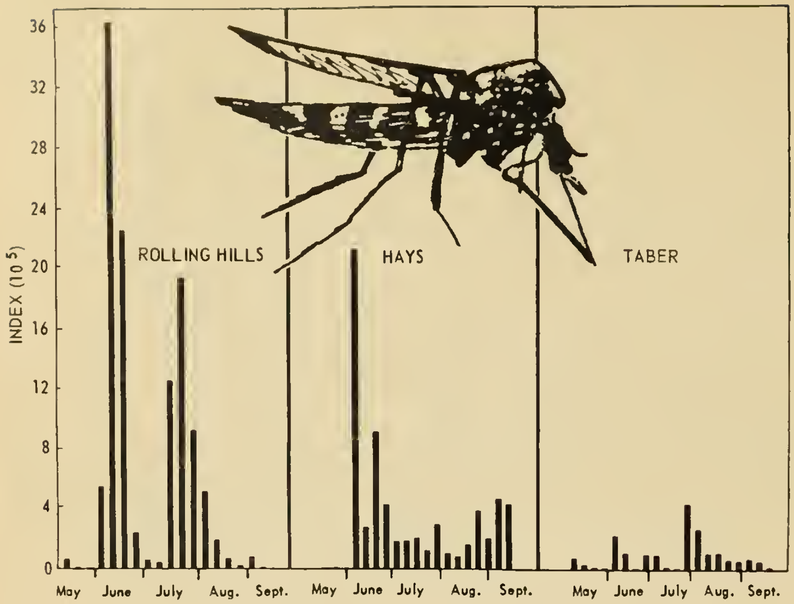
Mrs. P. Saidak and Hugh Hamilton were Dr. Asselbergs' assistants on this project. Similar products are being imported in increasing quantities into Canada and some are made in this country. The freedom of Canadian firms to make instant mashed potatoes is, however, restricted by patent control of the other processes available. It was important, said Agriculture Minister Hamilton, that Canadian potatoes should not lose out to imported potatoes merely because Canadian organizations did not have access to a suitable process. At the request of representatives of the potato industry the research for another process was undertaken and when this was accomplished the government took the step of patenting it. The Minister added that the commercial adaptation of the process will have to be the responsibility of any firm to which a licence to manufacture is given.

Dr. Asselbergs, somewhat surprised by the enthusiasm with which his achievement was greeted, said he would prefer not to comment until the product had actually proved itself on the market. Instant mashed potatoes are expected to give a boost to potato use especially in large establishments where the chores of peeling and cooking will be bypassed.

Economists reported to the dominion-provincial agricultural conference in November that the reversal in per capita consumption of potatoes in the United States from a decline to an advance was due to the popularity of processed potatoes. In Canada the market for instant mashed potatoes was stimulated by the appearance in 1960 of several new brands as well as renewed sales activity for some of the older forms of the product. The sharp rise in imports of dried potatoes into Canada included this product.

Pre-cooked dried potato flakes and granules (forms of instant mashed potatoes) had been coming in duty free. In the 1960-61 budget a duty of $17\frac{1}{2}$ per cent was imposed on imports of dry potatoes coming in after April 1, 1960.

The large number of manufacturers who have tested the product developed by the Asselbergs process have had nothing but praise for it. Potato growers are just as hopeful for its success as it may well create a large market for their crops.



Comparison of mosquito abundance in three representative irrigation districts of southern Alberta. Rolling Hills is a 40-year old district with roads and irrigation laid out in a grid system. Hays and Taber areas have been in operation for six years, the former laid out on the contour system, the latter on the grid system.

Impact of Irrigation on Mosquito Problems

W. O. Haufe AND *J. A. Shemanchuk*

ALMOST one million acres of farm land are under irrigation in Alberta and Saskatchewan and further irrigation development is proposed for an additional two million acres. This manipulated supply of water has turned dry land into highly productive areas of diversified agriculture with new opportunities for the farmer. At the same time however it has changed the original environment, especially the microclimate, of large areas of open prairie. Direct changes are caused primarily through creation of additional aquatic habitats by excess water in run-off or seepage and through increased evapotranspiration from the soil and fast-growing crops. Indirect changes are gradually established in time through the influence of more permanent plant growth such as pasture crops, shelterbelts, and farm groves of trees. Trees planted on the prairie provide new environments and habitats for the introduction of different animal communities, particularly those including insects and birds new to the locality. The analysis of changes in these associations of animals and environments is of primary importance in the protection of man and livestock from biting pests and insect-borne diseases. In the case of some insect-borne diseases such as western equine encephalitis, wild birds are reservoirs for the disease-producing virus that is transmitted from animal to animal by certain species of mosquito. Changing associations among man, domestic animals, and populations of mosquitoes and birds largely influenced by physical environments is believed to be the major factor in epidemics.

Man's persistent determination to manipulate his environment to his own advantage cannot be based entirely on immediate economic objectives. Severe disturbances in the balance of nature, if inadvertantly overlooked or intentionally unrecognized for long, may easily cause long-range economic agricultural problems that are also hazards to the health and welfare of man and his domestic animals. Indiscriminant use of water in some farm operations has already caused conditions that are undesirable for the future development of irrigated areas. One of these conditions is the increased provision of aquatic habitats for the unrestricted development of abundant populations of mosquitoes. Mosquitoes pose an immediate problem in the older irrigated areas by adversely affecting economic production of livestock and dairy products, by reducing the efficiency of farm workers, by increasing expenditures for pest control in urban areas, by limiting development and use of recreational facilities, and, in some cases, by reducing real estate values in rural and urban development. In the long-range view, an important question is whether growing communities of man and animals in irrigated areas may become focal points for epidemic diseases of nature communicable through the bites of numerous mosquitoes.

The problems of protecting man and animals in irrigated areas from attack by increasing populations of mosquitoes and of pre-

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venting insect-borne diseases are receiving considerable attention in the veterinary-medical entomology program at the Lethbridge Research Station. Recent research has shown that the average population of mosquitoes in irrigated areas is more than twenty times that in dryland areas. Broods of mosquitoes are produced on dryland prairie only when the rainfall exceeds 3.5 inches within a four-week period. The first major application of water in irrigated areas is sufficient to produce the most numerous annual brood. Heavy populations are maintained by additional broods with the second and third applications of water. Present irrigation methods provide favorable conditions for mosquito development throughout the irrigation season of June to August.

In view of the ability of mosquitoes to develop resistance to insecticides it is doubtful that chemical control is a completely satisfactory means of permanently reducing populations in some environments. Frequent and extensive applications of insecticides as required during the growing season in irrigated areas would be costly and impractical except for the protection of urban communities. It is also essential from the long-range viewpoint to cope with outbreaks of insect-borne diseases of man and animals and to provide an adequately effective chemical control for emergency purposes. In the case of an insect-borne disease such as western equine encephalitis for which no effective vaccine has yet been developed for man, protection for a community following an outbreak is afforded only by the elimination of disease-carrying mosquitoes. If insecticides are kept in reserve for this purpose, control of epidemics in irrigated areas is less likely to be frustrated by the development of resistance in species.

Cultural methods of controlling mosquitoes, such as by carefully managing irrigation flooding, constitute one possibility as an alternative to chemical control in irrigated areas. Our research is presently directed toward two objectives. First, we are determining the conditions under which mosquitoes are able to perpetuate large populations. This includes investigation of factors contributing to development, reproduction, and the habits of mosquitoes in attacking man and certain species of mammals and birds. Other important links required in our knowledge of mosquitoes are the associations, on the one hand, between species that carry disease organisms and the animals or birds that serve as disease reservoirs, and, on the other hand, between the same species and man or domestic animals that are accidently infected in the course of unusual changes of environment. If the behaviour and development of disease-carrying mosquitoes are understood in sufficient detail it is possible, not only to foresee outbreak situations for disease and to take adequate emergency precautions, but also perhaps to manipulate one or more key environmental factors to interrupt the life cycle and to reduce populations. For example, we know from some of our laboratory experiments that atmospheric moisture is a critical factor in modifying or limiting activity cycles in mosquitoes. This has been verified in the field and it explains how one species can associate with disease reservoirs and be a menace during one season or in one locality and not in another. Serological tests on samples of mosquitoes from the same populations are used to determine the type of mammal or bird that a species contacts in its blood-feeding habit. By combining these and other types of information we eventually understand how certain changes in our agricultural environment may directly or indirectly create the conditions for pests and some diseases affecting man and animals.

From the practical point of view it is important to determine whether, in farm management, water may be regulated to meet seasonal requirements for crop production without supplying the requirements necessary in mosquito habitats for all phases of development and reproduction. A comparison of mosquito populations in three representative irrigated areas in southern Alberta has shown that water management

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Alkali salt deposits resulting from repeated accumulations of water in poorly drained areas. These areas rapidly become unsuitable for cropping; serve as reservoirs for waste water suitable for mosquito breeding.

Accumulation of water in roadside ditches, common in irrigation areas laid out on a grid system.

A seepage pool along a main irrigation canal near Rolling Hills, Alta.

A roadside ditch in one of the newer irrigation districts, rapidly overgrowing with aquatic vegetation and a great source of mosquito breeding.

A healthy 4-year-old cherry tree.

A 4-year-old tree infected with necrotic ring spot at 2 years of age.

A 4-year-old tree infected with cherry yellows at 2 years of age.

Necrotic Ring Spot and Cherry Yellows . . .

Virus Diseases of Sour Cherry
in Niagara Peninsula

T. R. Davidson AND J. A. George

THE two most important virus diseases of sour cherry in the Niagara Peninsula are necrotic ring spot and cherry yellows. The virus nature of these diseases was first recognized twenty years ago. It is now known that one or other, or both, of these diseases is present in nearly all sour cherry trees that are over 10 years of age. There is no known treatment that will cure a tree once it is infected. However, simple precautions can be taken to insure that only virus-free trees are planted. Since 1950, virus-free budwood, maintained by the Horticultural Experiment Station, Vineland, Ont., has been available to nurseries and growers. The use of this material by many nurseries has resulted in a marked improvement in the quality of sour cherry trees offered for sale. The problem facing the grower is to maintain an orchard in a virus-free, or nearly virus-free, condition. The factors affecting the rate of spread of these viruses into healthy orchards and their effect on growth is being studied at the Department's Research Laboratory at St. Catharines, Ont.

Shock Symptoms

We have found that a severe symptom phase called "shock" is usually the first indication that a tree has become infected by either or these viruses. Shock occurs at the first bud-break following infection and is characterized by delayed leafing that may be general or confined to a portion of a tree. In the delayed part of the tree, the first leaves are smaller than normal and many develop numerous brown spots and rings. The brown areas frequently drop out and the leaves appear ragged. Shock is most apparent at the beginning of the season as leaves produced later are normal and mask the leaves showing symptoms.

Infection by yellows is always followed by shock symptoms but it has been found that ring spot infection can occur without shock. In tests at St. Catharines, trees that were inoculated with ring spot during May, June, or July later showed only secondary etch symptoms. Indeed, under natural conditions, some trees became infected without visible symptoms of any kind.

Secondary Symptoms

Our experiments revealed that in the years following shock, the most striking symptom of yellows infection is the development of a yellow and green mottling of some of the leaves during the third week in June that is followed by the casting of these leaves. The coloring appears first as a pale green, or yellowish, mottle on any part of the leaf and it may eventually involve the entire leaf. Often the area along the main veins remains green. Cast leaves may display all stages in the development of the yellows symptoms from little or no mottle to almost complete yellowing. These symptoms are usually visible for only a week or two each year.

The annual severity of the yellows symptoms is determined to a large extent by temperature. Mild weather preceding bloom fol-

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lowed by cool conditions during and following flowering increases the incidence and severity of the symptoms. For example, unusually cool temperatures during May, 1960, resulted in the occurrence of yellows symptoms over an unusually long period.

In our investigations we noticed that the typical recurrent symptom of ring spot is a relatively inconspicuous etching on the first leaves that develop each spring. This consists of minute rings and partial rings that have a water-soaked appearance but never become truly necrotic. Affected leaves are often somewhat pinched and roughened. There is a wide variation in the severity of these symptoms. Certain mild strains of ring spot induce no secondary symptoms.

We are conducting surveys on spread in a number of orchards planted with trees propagated from virus-free budwood. They reveal that little or no spread occurs among trees in orchards under four or five years of age. However, we have observed that if diseased trees are present in, or near, an orchard over five years old, spread can be very rapid. Ring spot has spread more rapidly than yellows in all orchards and in five of them the ratio of ring spot to yellows is 9:1, 18:1, 49:13, 54:8 and 2:0.

Rate of Spread Affected

Our investigations show that the rate of spread of these two viruses seems to be greatly affected by two factors: the percentage of diseased trees in the nursery stock, and the proximity of the new planting to older diseased trees. Many nurseries make use of virus-free budwood and, as a result, there has been an improvement in the quality of sour cherry nursery stock during the past 10 years. However, the value of virus-free buds is lost when they are placed on virus-infected rootstock. Nearly all rootstock used in Canada is imported and tests have shown that up to 10 per cent of the rootstock currently available from Europe and some parts of the United States is infected. Virus-free rootstock is easily grown from the seed of isolated healthy trees and is now available in limited supply. More sources will probably become available as the value of this rootstock is realized and grower demand increases.

Our studies show that the proximity of diseased trees seems to be of major importance in the spread of virus into healthy orchards. One virus-free test orchard was planted next to a row of diseased trees and after seven years this orchard is 74 per cent infected. A comparable orchard was put in 75 yards from a disease source and it is less than three per cent infected. We have found that other orchards separated from known virus sources by varying distances have remained virus-free for four years or longer. The distance that the virus will spread in any one year is not known but trees 200 yards from a known source have become infected.

Experiments at St. Catharines showed that both ring spot and yellows caused a marked reduction in growth of young trees in the year of infection. In subsequent years ring spot infected trees tended to recover but trees infected with yellows remained retarded. Over periods of three and four years, young trees infected with the yellows virus made only $\frac{1}{5}$ to $\frac{1}{4}$ as much growth as healthy trees. Ring spot infected trees under the same conditions made about $\frac{2}{3}$ the growth of healthy ones.

To date no data on the effect of these viruses on yield is available for the Niagara Peninsula. However, workers in other areas report that both viruses cause a gradual reduction in yield over a period of years. The yield can eventually be reduced by 50 per cent or more. The quality of the fruit is not affected. In fact, because of the lower fruit set, fruits from diseased trees may be larger than those from healthy trees.

Control

Our investigations have proven that the most effective means of controlling these viruses at present is by the use of virus-free nursery stock. It must be remembered that both the rootstock and the budwood must be virus-free. In the propagation of sour cherries the use of virus-free buds and rootstocks results in a higher bud-take and, because of better growth, a higher percentage of usable plants than when virus-infected material is used.

As our research has shown new plantings should be placed as far as possible from old, diseased trees. The distance required to give complete protection is not known but 200 yards is currently recommended. Shorter distances, however, may give considerable protection for a number of years.

Plant virus diseases present a real challenge to the researcher. Our studies on factors affecting their rate of spread into healthy orchards and their effect on growth have revealed certain information—and our search for more continues.

Impact of Irrigation on Mosquito Problems . . . *from p. 12*

may be used to reduce mosquito breeding without seriously affecting the function of irrigation systems. The Rolling Hills area has a 40-year old irrigation system with inadequate provision of drainage. A livestock economy and excessive flooding of hay fields and pastures provide ideal habitats for extremely high populations to breed in close proximity to animal hosts. The Hays area, a more recent development, has adequate drainage facilities and specializes in cereal crops. Mosquito populations in this area are still almost as high as those at Rolling Hills because farmers fail to control flooding even at the expense of small parts of their crop. The Taber area is largely devoted to high-priced row crops that are supervised closely by contractors and irrigated with specified amounts of water. Although adequate drainage facilities are lacking in this irrigation system the rigorous control of water on farms has prevented populations of mosquitoes from seriously exceeding those on dryland prairie in average seasons. It is difficult to visualize a completely mosquito-free irrigation system, but it is not too much to hope that scientific approaches in irrigation development can produce cultural methods that at least reduce the population potential.

Left: Young Hereford calves at Ottawa, being maintained at three levels of feeding to determine effect of the ration on gain and growth of cattle during winter. In spring, half of each lot will be implanted with the hormone diathystilbestrol to determine its effect while cattle are on pasture and in relation to their winter gain which involved no hormone.

Below: Federal Agricultural Minister Alvin Hamilton visits scene of experiment with Paul Sylvestre, Animal Research Institute.

Growth Promoting Hormone Used . . .

Fattening Long-Yearling Steers

P. E. Sylvestre

INTENSIFICATION of production and more efficient utilization of roughages and pasture are the keys to lowering the cost of production and to obtaining greater return per farm. With this purpose in mind, in Eastern Canada, we are attempting to shorten the production cycle by endeavoring to finish yearling steers at 18 months of age, at weights approaching 1,000 pounds in the fall, using a maximum of roughages and pasture and a minimum of grain. If this can be achieved, the growing and fattening periods may be reduced by approximately six months. By reducing the finishing period a farmer would have more available shelter and feed making it possible to purchase additional calves or keep more cows.

In a series of experiments, we propose to study factors which may have an effect on beef production such as date of birth, date of weaning, levels of nutrition during wintering and their subsequent effects on pasture gain, and the effect of hormones on winter and summer gain and on efficiency of feed utilization. Pasture production and management, and grain feeding on pasture and in dry lot will also be studied.

In a recent experiment, we found that levels of feeding weaned calves during winter affected the winter gain directly but the summer gain inversely. Thus, weaned calves wintered on a roughage ration supplemented with six pounds of grain, gained 220 pounds in 140 days and 174 pounds during the subsequent pasture season of 150 days. On the other hand, calves wintered on roughages only, gained 28 pounds and 283 pounds for corresponding periods. When the ration was supplemented with 2 and 4 pounds of grain, we got only intermediate results. Although the six pounds grain-fed steers finished earlier and at a slightly heavier weight, the two and four pounds groups were the most economical.

The non-supplemental group did not finish in the time laid down.

Stilbestrol fed orally (10 mg. daily) during winter had no significant effect on the gain and feed efficiency of the animals. There was also no carryover effect on the gain the following summer.

Grass is generally considered to be the cheapest feed. Thus, if an animal makes most of its gain on pasture, there should be a reduction in feed cost. In a current experiment we hope to determine the effect of stilbestrol implants (24 mg. per head) on the pasture gain of yearling steers previously submitted during winter to the following levels of feeding: roughage only, roughage supplemented with 2 and 4 pounds of grain respectively. Preliminary results indicate that the increase in gain due to the hormone-like substance were in the following order: 50%, 35% and 0% for roughage only, 2 pounds and 4 pounds of grain respectively. The large increases in the lower levels, and the nil effect on the high level, are of such importance that the experiment needs to be repeated.

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